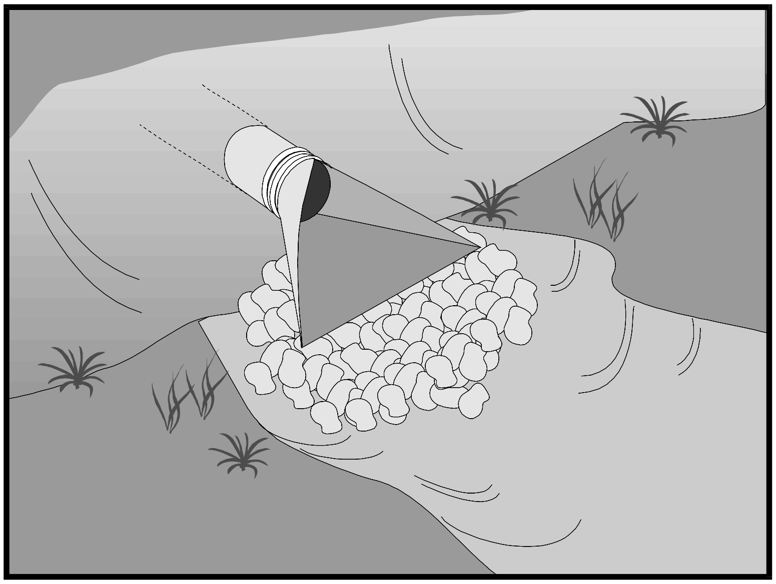
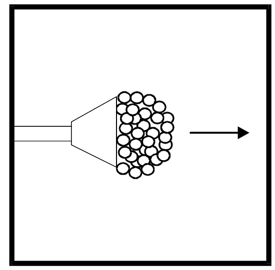
Outlet Protection/ Velocity Dissipation Devices





BMP Objectives

- ● Soil Stabilization
- ○ Sediment Control
- ○ Tracking Control
- ○ Wind Erosion Control
- ○ Non-Storm Water

Definition and Purpose

Outlet protection/velocity dissipation devices are physical mechanisms placed at the outlets of pipes and channels to prevent scour and reduce the velocity and/or energy of storm water discharges.

Appropriate Applications

- Where localized scouring is anticipated, such as outlets of pipes, drains, culverts, slope drains, diversion ditches, swales, conduits or channels.
- Outlets subject to short, intense flows of water, such as from flash floods.
- Where lined channels or ditches discharge to unlined conveyances.

Limitations/ Precautions

- Loose riprap may have stones washed away during high flows.
- Grouted riprap may break up in areas of freeze and thaw.
- If there is not adequate drainage and water builds up behind grouted riprap, it may cause the grouted riprap to break up due to the resulting hydrostatic pressure.

Design Guidance

- There are many types of energy dissipaters; rock, which is represented in Figure 1, is one common type. However, note that this is only one example and the District Hydraulics Engineer must be contacted for region-specific requirements.
- Common device for outlet protection is a structurally lined apron, lined with riprap, grouted riprap or concrete apron. Also see BMP for Flared Culvert End Sections.

- Apron length is related to outlet flow rate and tailwater level.

- For proper operation of apron:

  - Align apron with receiving stream and keep straight throughout its length. If a curve is needed to fit site conditions, place it in upper section of apron.

  - If size of apron riprap is 300 mm (12 in) or larger, protect underlying filter fabric with 100 mm (4 in) minimum gravel blanket to prevent loss of soil material beneath riprap.

- For outlets located at the top of a slope, the areas receiving the discharge should have additional erosion protection from the re-concentrated, high velocity flow that is leaving the structural apron.

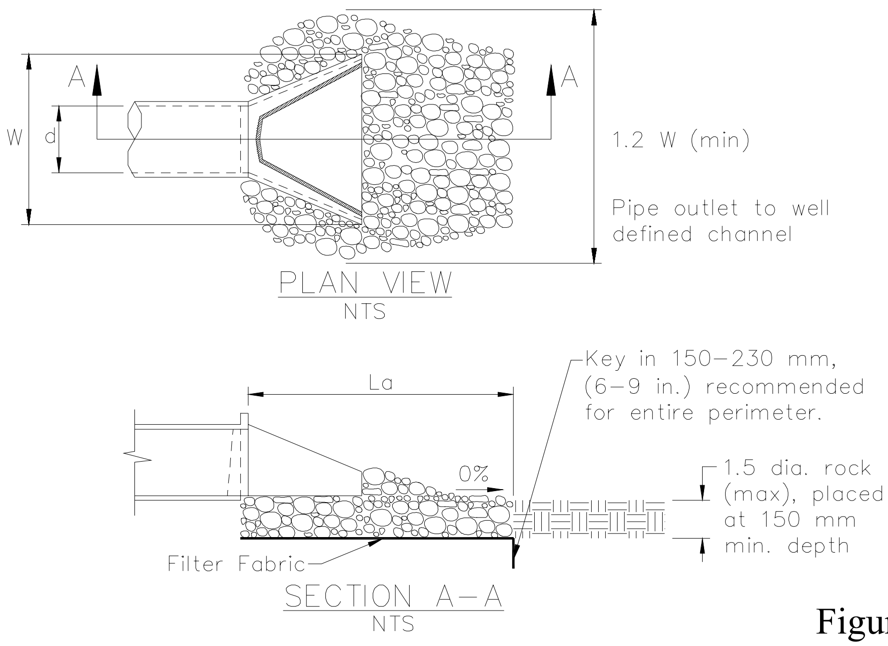


Figure 1

Pipe Diameter mm	**Discharge** m^3/s	**Apron Length, La** m	**Rip Rap** **D_{50} Diameter Min** mm
300	0.14 0.28	3 4	100 150
450	0.28 0.57 0.85 1.13	3 5 7 8	150 200 300 400
600	0.85 1.13 1.42 1.70	5 8 8 9	200 200 300 400
For larger or higher flows, consult a Registered Civil Engineer			

Source: USDA – SCS

ROCK ENERGY DISSIPATER AT CULVERT OUTLET

From Caltrans District 1 (circa 1980), revisions by James A. Racin, P.E. (916-227-7017) 20 Aug. 1999: length, metric table (rock size, trench depth, RSP-fabric), determining rock size.

Design Notes:

1. Determine **rock size** based on **culvert outlet velocity**.

   A. 1st trial rock size by N.K. Berry's equation (1948), see USBR EM-25:

   $$\mathbf{d = 0.0126\ V^2}$$

   Where: d = diameter (ft), V = velocity (fps), specific gravity = 2.65

   B. Compare to Caltrans Bank & Shore Equation 1. With 1:1.5 (V:H) (if H>1.5, size will be small) and specific gravity = 2.65

   $$\mathbf{W = 0.0000568\ V^6}$$

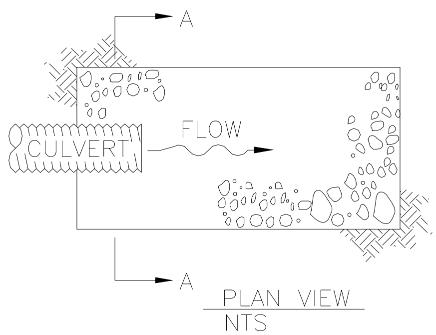
   Equation 1 gives rock size on bank, usually smaller than size from Berry equation for bedload movement along channel bottom.

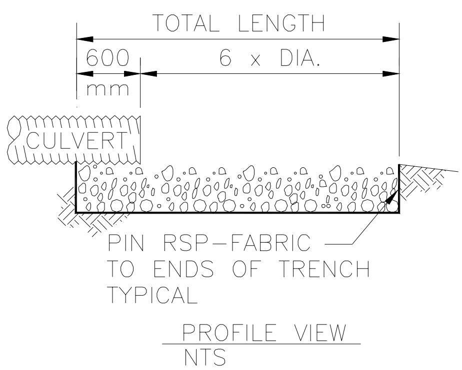
   C. Also compare above rock sizes to HEC-14 chart, Figure II-C-1, on page II-9 (1975), originally form Searcy (1967).

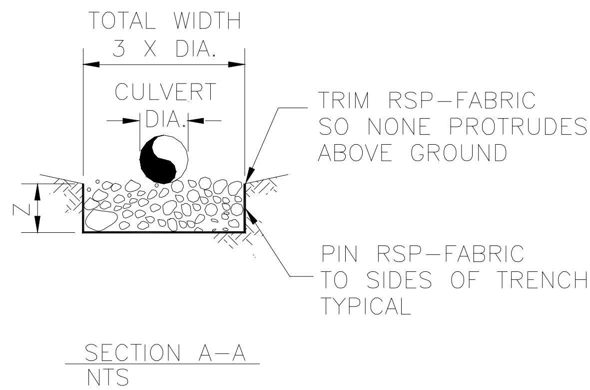
   D. Select final rock size based on engineering judgment and field experience at similar sites.

2. When downstream channel requires rock bank protection, compare dissipater rock size to bank rock size.

3. Adjust length (increase or decrease) based on site-specific constraints.







Construction note: Length, width, depth dimensions are approximate, (squared-off excavation not required).

Rock Size RSP-class	Z Trench Depth Range (mm)	Type of RSP-fabric Non-woven or Woven
Backing No. 2	250 – 400	A or B
Backing No. 1	300 – 450	A or B
Light	450 – 600	B
¼ T	750 - 900	B
½ T	900-1100	B
1 T	1200 – 1500	B